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YUKON STOCK SEP. REPORT #4

YUKON RIVER SALMON TAGGING STUDIES

1965-1966

(From 1966 AYK Annual Mangt. Report)

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INTRODUCTION

This report discusses tagging and recovery projects conducted during 1965 and 1966. In 1965 all salmon were tagged at the Flat Island site, while salmon were tagged at two sites, Flat Island and Middle Mouth, during 1966. Salmon have been tagged at the Flat Island site since 1963 which is located in the South Mouth approximately five miles northwest of Sheldons Point. The Middle Mouth site is located at the mouth of Kawanak Channel (Middle Mouth), and 1966 marked its first year of operation.

The main objectives of these studies were to determine run timing, differentiation of races, migration rates, population size and percentage utilization by the commercial fishery of the salmon runs. Although all species are tagged, these studies are designed for study of king salmon.

METHODS

Gill nets of varying mesh sizes were operated for the purpose of capturing salmon for tagging. In addition a single fishwheel was operated for the same purpose at Flat Island during 1965. Most of the fishing gear, including the fishwheel, was operated near the north bank of the South Mouth at the Flat Island site and near the south bank at the Middle Mouth Site.

Captured salmon were tagged with spaghetti tags consisting of 13 inch lengths of yellow plastic tubing, 1/16 inch in diameter. These tags were inserted with a special needle applicator approximately one inch below and slightly forward of the insertion of the dorsal fin. The tag legend included reward information and the mailing address of the Anchorage Office of the Alaska Department of Fish and Game.

A one-dollar reward was offered for each tag recovery made

and publicity notices were posted in every village throughout the Alaskan portion of the drainage. Canadian Department of Fisheries personnel collected tag recoveries in Yukon Territory. Most of the tag recoveries made by commercial fishermen were returned attached to fish tickets. These fish tickets are completed when salmon deliveries are made to tender boats or shore plants and show the fisherman's name, date of catch and area of catch. Other recoveries were either collected by Department personnel or were mailed to the Anchorage Office by fishermen.

It was not possible to estimate the number of tags not returned but because of the widespread knowledge of the program and the publicity given to it, the numbers of unreported tags are believed to be small. Also the lack of tags returned from previous years tends to support this view.

The sex and fork length were recorded for every salmon tagged. Each tagged salmon was classified as to its condition upon release. Fish classified as Category I were considered in good condition, Category 2 consisted of fish of questionable condition, and Category 3 were considered to have been released in poor condition. Salmon that were taken from the net in very poor condition, i.e., bleeding from the gills, were not tagged. These fish were sampled for age, sex and size information and then were given to local processors or subsistence fishermen.

RESULTS - KING SALMON

Numbers Tagged and Captured

Table 18 shows the daily numbers of king salmon tagged and captured during the 1965 and 1966 seasons. A total of 1,116 king salmon was captured during the 1965 season of which 819 were tagged. In 1966, a total of 976 king salmon was captured of which 573 were tagged. About 33% of the total numbers caught both seasons were not tagged because of mortality or injuries sustained after capture.

Effect of the Commercial Fishery on Tagging Site Catches

The tagging sites were located at the river mouths where salmon could be captured, tagged and released below the majority of the commercial fishing gear. Locating the tagging sites within the commercial fishery would produce the following problems associated with the determination of recovery rates and run timing and magnitudes:

1. The commercial catches made downstream would effect run timing and magnitude at the tagging site.

2. Tagged salmon when released are often disoriented or weakened by the tagging and handling operation and tend to mill or move downstream prior to resuming normal migration. An increase in the amount of commercial fishing gear in and adjacent to the tagging site areas would increase the selectivity of tagged salmon.

Ideally the tagging sites should be located just outside the mouths and below all of the commercial fishery, but lack of suitable camp sites and logistic problems have made this impossible to date.

Since only about 5% (estimate 15-20 fishermen) of the Yukon River commercial fishing gear is operated below Flat Island, it was thought that the tagging site catches would not be influenced by the commercial catches. Table 19 compares Flat Island tagging site catches made by a 25 fathom gill net (8½ inch mesh) during days open to 0, 6, 18 and 24 hours of commercial fishing for 1963 through 1966. The largest tagging site catches during the 4 year period were made during days closed to commercial fishing (57 kings per day) and the smallest tagging site catches were made during days open 24 hours to commercial fishing (10 kings per day). Surprisingly, the data indicates that the small segment of the commercial fishery located below Flat Island does effect the tagging site catches to a considerable degree.

The commercial fishery apparently had little influence on the Middle

TABLE 19

Mean Catches of King Salmon Taken At Flat Island Tagging Site During Days Closed to Commercial Fishing and Open 6, 18 and 24 Hours, 1963-1966[1/]

	HOURS EACH DAY OPEN TO COMMERCIAL FISHING[2/]				
Year	0	6	18	24	Total
1963	70 (3)	48 (5)	15 (6)	16 (5)	34 (19.0)
1964	70 (1)	27 (1)	55 (1.4)	20 (1.5)	42 (4.9)
1965	45 (3)	17 (6)	31 (7.8)	9 (8)	22 (26.8)
1966	53 (3)	27 (6.4)	22 (4.3)	3 (5)	23 (18.7)
1963-1966	57 (10)	26 (20.4)	27 (19.5)	10 (19.5)	27 (69.4)

1/ Catches are from a single 25 fathom gill net 8½ inch mesh)

2/ Number of days on a 24 hour basis are shown in parenthesis.

Mouth tagging site catches in 1966. Although not documented, it is estimated that less commercial fishing gear was located below the Middle Mouth site as compared to the Flat Island site.

Run Magnitude and Timing

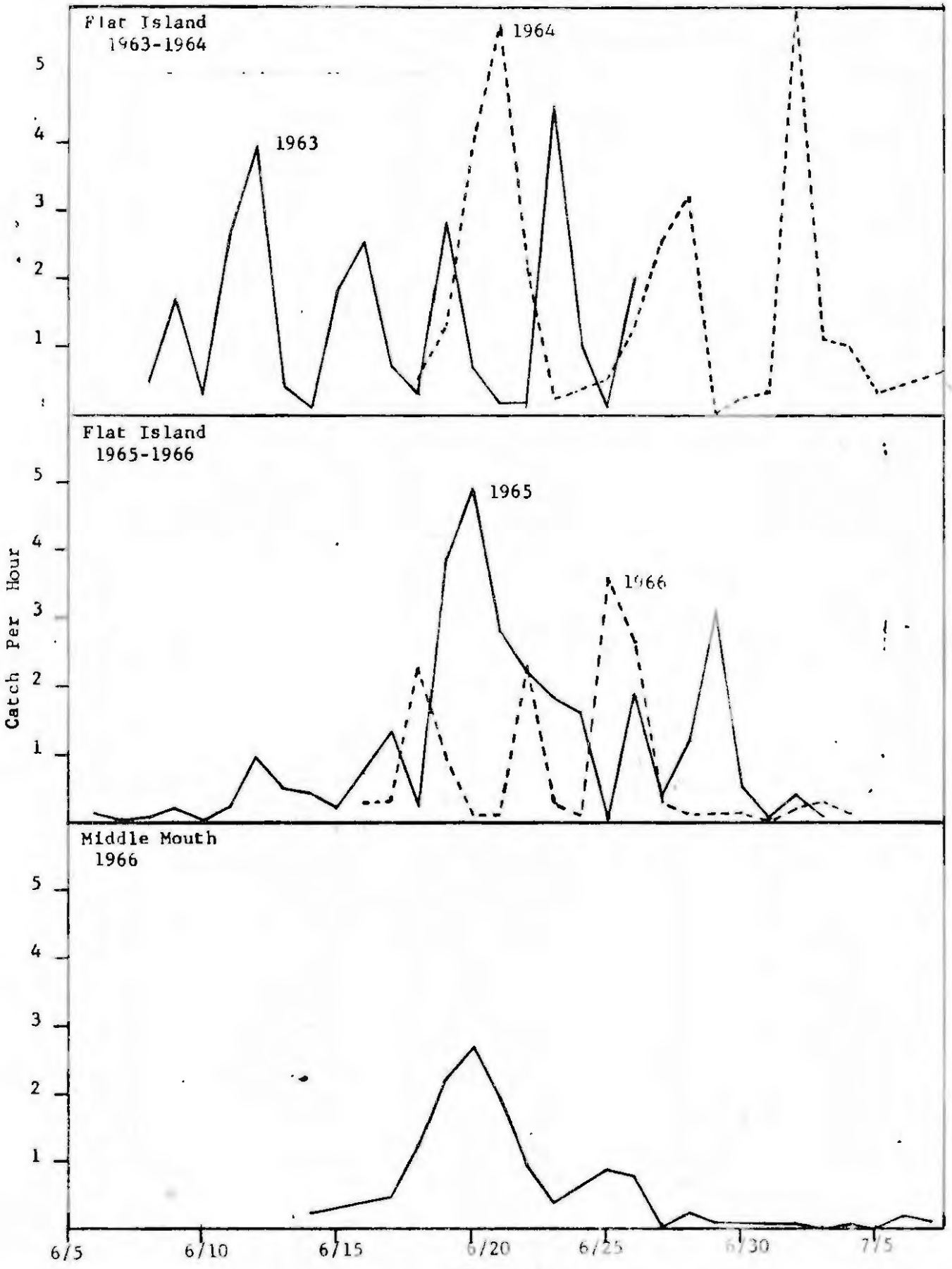
It should be pointed out that the catch per hour data presented in this report are probably affected by environmental conditions, varying fishing methods (position of the net, etc.) and other factors not necessarily related to salmon abundance. Also, as previously mentioned, the downriver commercial catches tend to limit tagging site catches. Even with these limitations, catch per unit of effort data is the best available indicator of run timing and relative run magnitude.

The catches shown in Table 18 do not necessarily reflect run magnitude or timing as varying amounts of gear were operated each day and season. A more meaningful indication of run magnitude and timing is shown in Figure 3. In this figure the catches per hour are compared for a 25 fathom gill net (8½ inch stretched mesh) operated during the 1963 - 1966 seasons. The Flat Island gill net was fished in the same general area each season. The figure does not show the timing and magnitudes of the early portion (first 2-4 days) of the 1963, 1964 and 1966 runs as a result of delays in setting out fishing gear. Appendix Table A-1 shows the number of hours fished and catch per hour for the Flat Island tagging site during 1963 - 1966.

The mean catch per hour (25 fathom, 8½ inch mesh net) at Flat Island was .89 and .77 for the 1965 and 1966 seasons respectively. The catch per hour for the middle mouth site was only .42 in 1966. This data, in support of commercial catch data previously discussed, indicates that the 1966 run into the South Mouth was similar or slightly smaller than in 1965, but the total Yukon River run was considerably smaller than in 1965 because of the indicated small Middle Mouth run.

FIGURE 3

King Salmon Catch per Hour with a 25 Fathom gill net (8½ inch mesh)
Fished at Yukon River Tagging Sites during 1963-1966.



The mean catch per hour (25 fathoms, 8½ inch mesh net) at Flat Island was 1.40 and 1.55 for the 1963 and 1964 seasons respectively. Fewer days were fished and porportionately more of the fishing time occurred during the peak of the 1963 and 1964 runs. Therefore when comparing catch data for all four seasons (1963 - 1966), the 1963 and 1964 South Mouth runs were probably not as large as that indicated.

Gear Efficiency

Table 20 compares the catch per hour of various types of gear that were operated on similar dates during 1965 and 1966. This data shows that 8½ inch mesh gill nets were the most efficient in the capture of king salmon followed by 7 inch mesh gill nets and 10 inch mesh gill nets. The fishwheel, operated in 1965, captured king salmon at about the same rate as the 10 inch mesh gill net. Gill nets of 5½ inch mesh were fished only during periods of low king salmon abundance, and thus the comparisons with 8½ inch mesh gill nets are probably not valid. The various types of gear were fished in different locations in the vicinity of Flat Island which also probably influenced the catches to some degree. Appendix Table A-2 shows the numbers of salmon tagged and captured including the catch per hour data for all types of gear operated during 1965 and 1966. It is not possible to draw conclusions regarding gear efficiency in respect to capture of king salmon for much of this data as the various types of gear were not always fished on similar dates.

Sex and Size Composition of Tagged King Salmon

As shown in Appendix Table A-3, tagged king salmon taken in all gill nets during 1965 and 1966 were composed of approximately 60% males and 40% females, each having mean fork lengths of about 89 centimeters (orbit lengths of 82-83 cm.). Tagged king salmon captured with 10 inch mesh gill nets in 1965 had mean fork lengths of 91.6 cm. compared to 89.4 cm. and 84.5 for

TABLE 20

Catch Per Hour of King Salmon Recorded for Various Types of Gear, Yukon River, 1965-1966
(All Nets were 25 F. in Length)

Type of gear	Year	Dates Fished	Hours Fished	Catch Per Hour
GILL NETS				
10 inch mesh[1/]	1965	6/13-14	376	.22
8½ inch mesh		6/16-7/2	456	1.44
7 inch mesh[1/]	1965	6/13,14,16,17,20	128	.91
8½ inch mesh		21,23,24,27	216	1.58
7 inch mesh[1/]	1966	6/13-16,6/23	117	.26
8½ inch mesh		6/29-30,7/7-8	198	.76
5½ inch mesh[1/]	1966	6/13-16	190	.08
8½ inch mesh		7/2-8	212	.02
5½ inch mesh[2/]	1966	6/28-7/10	225	.07
8½ inch mesh			238	.08
FISHWHEEL[1/]	1965	6/8-7/4	503	.23
GILL NETS (ALL MESH SIZES)			2,037	.49

1/ Flat Island Site

2/ Middle Mouth Site

8½ inch and 7 inch mesh gill nets respectively.

The mean fork length of all king salmon captured by the fishwheel in 1965 was 79.7 cm., almost 10 centimeters less than the gill net sample (all mesh sizes). This was the first known instance of a fishwheel being operated at the river's mouth. Previous studies in the Taku River have shown that fishwheels are selective to the smaller sized king salmon. Although the fishwheel probably "selected out" the smaller sized king salmon, it may have taken a more representative sample of the run than any of the gill nets.

Tag Recovery

General: Table 21 shows the numbers of king salmon tagged and recovered during the study period. In 1965 a total of 318 or 38.8% of the king salmon tagged at the Flat Island site was recovered. The 1966 recovery rates were 26.5% (n=104) for Flat Island tags and 37.6% (n=68) for Middle Mouth tags for a combined value of 30.0% (n=172).

Over 90% of all recoveries each season were taken in the lower 279 miles of river with 8½ inch mesh gill nets, most of which were operated by commercial fishermen.

Differences in Recovery Rates: The 1966 recovery rate for Flat Island tagged king salmon was considerably lower than that recorded for the Middle Mouth site during the same year and for the Flat Island site during 1965. These differences may be a result of the following factors:

1. Greater mortality of Flat Island tagged king salmon. Although tagged mortality may have been a contributing factor, it is very doubtful that it could have accounted entirely for these differences. Approximately 25% of the king salmon tagged at Flat Island in 1966 would have to have sustained mortality to account for the differences in the recovery rates

TABLE 21
Numbers of King Salmon Tagged and Recovered
During 1965-1966, Yukon River1/

Tagging Gear	Flat Island, 1965		Flat Island, 1966		Middle Mouth, 1966		Totals, 1966	
	Tagged	Recovered	Tagged	Recovered	Tagged	Recovered	Tagged	Recovered
10 inch mesh	63	23(36.5%)	0	-------	0	--------	0	--------
8½ inch mesh	597	246(41.2%)	377	104(27.5%)	172	66(38.4%)	549	170(31.0%)
7 inch mesh	48	11(22.9%)	10	0(0)%	0	--------	10	0(0%)
5½ inch mesh	0	------	5	0(0)%	9	2(22.2%)	14	2(14.3%)
Totals - gill net	708	279(39.4%)	392	104(26.5%)	181	68(37.6%)	573	172(30.0%)
Fishwheel	111	38(34.2%)	0	-------	0	--------	0	---------
Totals - All Gear	819	318(38.8%)	392	104(26.5%)	181	68(37.6%)	573	172(30.0%)

1/ % recovery in parenthesis

noted.

2. Approximately 50% of the Flat Island tagged king salmon were released after June 22 when commercial fishing time was reduced from 4 to 3 days a week in the lower 160 miles of river. By comparison only 33% of the Middle Mouth tagged kings were released after June 22. Therefore king salmon tagged at Flat Island, as a group, were exposed to less fishing effort during 1966.

Distribution of Tag Recoveries by Recovery Location: Table 22 shows the distribution of 1965 and 1966 tag recoveries for various locations in the Yukon River drainage. Differences in the distribution of tag recoveries between the two tagging sites in 1966 are largely dependent on the distribution of commercial fishing gear. For example a much greater amount of gear was fished in the South Mouth area especially near Flat Island when compared to the Middle Mouth area. The majority of the Flat Island recoveries were made in the lower 24 miles of the South Mouth, while the majority of the Middle Mouth site recoveries were made above Fish Village. Only 1.9% and 3.5% of all the 1965 and 1966 recoveries respectively were made above Mile 279.

The movement or distribution of tagged salmon after release in the lower river is important in evaluating tag recovery data. In order to obtain unbiased data necessary in harvest rate and population size computations, the tagged salmon should be randomly distributed within the migrating population. For example a majority of the king salmon tagged at the Flat Island site were captured near the north shore. It was speculated that after release these salmon would not "mix" with the untagged portion of the run but would continue to migrate upstream along the north shore in the lower river.

The recovery location in respect to north and south shore was

TABLE 22

RECOVERIES OF TAGGED KING SALMON BY AREA
1965 - 1966

General Recovery Area	Mileages From Tagging Site	Recoveries By Tagging Site 1965 Flat Is.	1966 Flat Is.	1966 Middle Mouth	Total
South Mouth					
Below Flat Island	-	30	8		8
Flat Island (Tag. Site)	0	58	22		22
Flat Island - Alakanuk	1 - 11	69	29	1	30
Alakanuk	17	49	4		4
Kwiguk - Emmonak	24	46	13		13
Aproka - Kwikpak Passes	30 - 43	5	1		1
Middle Mouth					
Mouth (Tag. Site)	0			5	5
Snotty Slough	20			5	5
Lower Aproka Pass	25 - 35			4	4
New Hamilton	40			1	1
Recovery Location Unknown				6	6
North Mouth					
Hamilton	-			1	1
Main River					
Fish Village - Anuk River	52 - 63	21	12	14	26
Patsy's Cabin-Mt.Village	71 - 87	8	3	4	7
Old Andreafsky	97	3		4	4
Mouth of Andreafsky River	104	1		1	1
Goose Island	109	2	1		1
Pilot Station	122	6	4	8	12
Pilot Village	138	1	1	1	2
Marshall	161	1		2	2
Ingrihak	170		1		1
Russian Mission	213	2		1	1
Paimiut	251	1			
Holy Cross	279		2	2	4
Anvik and Vicinity	317 - 366	1			
Nulato	484			1	1
Ruby and Vicinity	553 - 582	4			
Tanana	695	1			
Rampart Canyon	720			1	1
Fort Yukon	1,002			1	1
Dawson	1,319		1	1	2
Carmacks	1,550		1		1
Recovery Area Unknown		9	1	4	5
Total Recoveries		318	104	68	172

obtained for 68 recoveries of king salmon tagged at Flat Island during 1966 (Table 23). Only those recoveries made below Mile 62 were used. Of the 68 recoveries, 43% and 57% were taken near the north and south shore respectively. The large numbers of north shore recoveries in the "Flat Island and Vicinity" area can probably be attributed to commercial fishing gear being operated near the release points for tagged salmon. The data in Table 23 shows a general random pattern of distribution of tagged salmon in the lower river. A more precise description of salmon movements cannot be shown since the actual distribution of commercial fishing gear was not documented.

Distribution of Tag Recoveries by Tagging Date: It has been suspected but never shown that the Yukon run is composed of separate races bound for different spawning areas, each possibly differing in run timing, relative abundance, productivity, etc. (See Annual Report for 1964, pgs 127-128). A tag and recovery program is one possible method of identifying and separating these races, assuming they differ in run timing and destination. Similar to that found in other large river systems (Columbia, Sacramento Rivers), Yukon king salmon bound for the upper portions of the drainage may migrate earlier in the season.

Table 24 shows the number of recoveries made by tagging date (10-day periods) for the area above Mile 484 during 1962, 1963, 1965 and 1966. The 1964 data was not used due to the unusual late season and entry of the run into the river that year. The 1963, 1965 and 1966 data represent salmon tagged at the river mouth (Mile 0) while in 1962 salmon were tagged at Mile 96. For comparative purposes, the grouping of the 1962 recoveries was obtained by subtracting 5 days from each tagging date (assuming a migration rate of king salmon of about 20 miles a day). In addition the percentages of total tags applied and total recoveries made above 484

TABLE 23

Recoveries by Shore Position of King Salmon
Tagged at Flat Island (North shore) During 1966[1/]

Recovery Location	North Shore Recoveries	South Shore Recoveries	Total Recoveries
Below Flat Island	0	8	8
Flat Island & Vicinity	16	1	17
Mile 3 - 9	10	17	27
Mile 17 - 24	1	6	7
Mile 30 - 43	1	0	1
Mile 52 - 62	1	7	8
All Locations	29	39	68

1/ Recoveries made above Mile 62 not shown

during each tagging period are compared in Table 24.

Tagging dates for salmon recovered above Mile 484 ranged from June 9 to June 30 during the 5 year period with the majority of recoveries having been tagged during June 11 to June 20. However the limited data shows that the percentage of total recoveries for each tagging period was dependent on the numbers tagged, and there was no indication that king salmon bound for the upper river migrated early in the season.

Recovery of King Salmon Classified as to Condition: Table 25 compares recovery of tagged salmon according to their condition upon release. Salmon classified as Condition 2 and 3 had lower recovery rates when compared to the Condition 1 group. This same tendency was found to occur in 1963 and 1964 studies which indicates a higher mortality rate of Condition 2 and 3 tagged salmon after release. This should be taken into account in population estimates or harvest rate computations.

Migration Rates of Tagged King Salmon: Table 26 presents the migration rates (miles travelled per day) for recoveries made in various areas of the river during 1965 and 1966. The mean migration rates of all recoveries were 11.8 and 21.2 miles per day during 1965 and 1966 respectively. The data indicates that the migration rate increases as the run progresses upriver. However migration rates calculated from tag and recovery data are probably influenced by the following:

1. Tagged fish may be released in a weakened or disoriented condition which results in their slower upstream progress, especially in the lower river.

2. The percentage of error in calculations of normal rates of travel is, in most cases, greater over the smaller the distances travelled before recovery is made.

TABLE 24

Tagging Dates of Yukon River Salmon Recoveries Made Above Mile 484 During 1962, 1963, 1965 and 1966

Tagging Dates	Number of Recoveries					Percentage of	
	1962	1963	1965	1966	Total	Total Recoveries 1/	Total Tags 2/
June 1-10	0	0	1	0	1	4	3
June 11-20	3	5	2	4	14	59	57
June 21-30	6	0	2	1	9	37	35
July 1-10	0	0	0	0	0	0	4
July 11-20	0	0	0	0	0	0	.8
July 21 +	0	0	0	0	0	0	.2
	—	—	—	—	—	—	—
Totals	9	5	5	5	24	100%	100%

1/ Recoveries above Mile 484

2/ Total Tags applied at all tagging sites

TABLE 25

Percentage Recovery For Tagged King Salmon Classified as to Condition During 1965 - 1966, Yukon River

Condition Classification	Numbers Tagged				Percentage Recovery			
	1965	1966			1965	1966		
	F.I.	F.I.	M.M.	Total	F.I.	F.I.	M.M.	Total
1	622	304	105	409	40.3	29.3	40.0	32.0
2	148	87	67	154	34.4	17.2	31.3	23.4
3	45	1	6	7	33.3	0	33.3	28.6
Unclassified	4	0	3	3	25.0	0	100.0	100.0
Totals	819	392	181	573	38.8	26.5	37.6	30.0

F.I. Flat Island Site

M.M. Middle Mouth Site

TABLE 26

Migration Rates of Yukon River King Salmon
Recoveries, 1965-1966

Recovery Area	1965 1/		1966 2/	
	No. of Recoveries	Average Miles Per Day	No. of Recoveries	Average Miles Per Day
Alakanuk-Anuk River	67	7.3	32	10.7
Mt. Village-Koyukuk	21	12.2	23	18.3
Above Koyukuk	3	28.1	5	30.6
All Areas	91	11.8	60	21.2

1/ All salmon tagged at Flat Island

2/ Alakanuk-Anuk River recoveries include only Flat Island tags. The other recoveries shown include both Flat Island and Middle Mouth tags.

Population Estimate

Any population estimate of the king salmon run must take the following factors into consideration:

1. Relatively small numbers were tagged and recovered.
2. Non-random tagging and recovery.
   (a) Salmon were not always tagged in proportion to their relative abundance.
   (b) Gear selectivity: Tagging site gear, mainly 8½ inch mesh nets, sampled a somewhat different age, sex and size segment of the run than did the upper river fishwheel fishery.
   (c) Tagged fish are more susceptible to capture in the lower river. This is a result of milling of tagged fish caused by their disorientation or weakened condition.
   (d) Tagged fish may not be randomly distributed with the untagged portion of the population. As discussed previously, this does not seem to be a problem for Flat Island king salmon tagged during 1966.
3. Tag Loss: There were one or two unverified reports by fishermen of salmon taken with missing tags.
4. Mortality of Tagged Salmon: Although salmon with bleeding gills or in a very weakened condition were not tagged, it is probable that a few died as a result of the tagging and handling operation.
5. Unreported Tag Recoveries.

Table 27 shows the relationship of tag recoveries to catches for various areas of the Yukon River during the study period. The ratios of recoveries to total catch for 1966 were more consistent when the data from both tagging sites were used versus the data from a single tagging site.

TABLE 27

RELATION OF TAG RECOVERIES TO CATCHES
OF KING SALMON FOR VARIOUS AREAS OF THE YUKON RIVER, 1965-1966
(INCLUDES YUKON TERRITORY CATCHES)

Area	Catches			No. of Recoveries	Recoveries: Total Catch
	Commercial	Subsistence	Total		
1965 (Flat Island)					
Mouth - Anuk R. (Y-1)	89,268	783	90,051	278	1:324
Anuk R. - Marshall (Y-2)	23,763	2,780	26,543	22	1:1207
Marshall - Holy Cross	3,204	3,744	6,948	3	1:2,316
Above Holy Cross	4,437	12,146	16,583	6	1:2,764
	120,672	19,453	140,125	318 1/	1:441
1966 (Flat Island)					
Mouth - Anuk R. (Y-1)	70,783	1,242	72,025	89	1:809
Anuk R. - Marshall (Y-2)	16,927	1,506	18,433	9	1:2,048
Marshall - Holy Cross	3,612	3,445	7,057	3	1:2,352
Above Holy Cross	5,038	8,069	13,107	2	1:6,553
	96,360	14,262	110,622	104 2/	1:1,064
1966 (All Sites)					
Mouth - Anuk R. (Y-1)	70,783	1,242	72,025	126	1:572
Anuk R. - Marshall (Y-2)	16,927	1,506	18,433	29	1:636
Marshall - Holy Cross	3,612	3,445	7,057	6	1:1,176
Above Holy Cross	5,038	8,069	13,107	6	1:2,185
	96,360	14,262	110,622	172 3/	1:643

1/ Includes 9 recoveries from unknown areas

2/ 1 recovery from unknown area

3/ 5 recoveries from unknown area

Table 28 presents a number of simple Petersen estimates of the 1966 run size using different sets of data. These estimates, excluding Methods VIII and IX, ranged from 310,000 to 387,000. Method VIII and IX are estimates of just the middle mouth and south mouth runs respectively. which totalled 282,264. This estimate does not include North Mouth (Apoon Pass), Kwiguk Pass, Alakanuk Pass and Bugomowik Pass runs.

The accuracy of these estimates is not known but Methods V-VII (310,000 - 342,000) are considered more reliable due to the following factors:

1. Only Condition 1 tags and recoveries were used.
2. Only subdistrict #1 and #2 catches or catches by 8½ inch mesh nets were used.
3. Recoveries and catches made in the vicinity of the South Mouth from Flat Island downstream were not included in the computations.

The population estimates, as shown in Table 28, are probably too high as a result of biases such as unreported tag recoveries, tag loss, mortality of tagged fish, etc.

RESULTS - CHUM SALMON

Numbers tagged and captured

Table 29 shows the daily numbers of chum salmon captured and tagged at all sites during 1965 and 1966. A total 1,065 was tagged at the Flat Island site during 1965 while a combined total of only 299 was tagged at two sites during 1966. More chums were tagged during 1965 due to the operation of a fishwheel which was relatively efficient in the capture of this species.

Run Timing

The first chum salmon was captured on June 9, 1965 and on June 14 at the Middle Mouth site in 1966. Sustained tagging site catches were made beginning June 12 and June 15 during 1965 and 1966 respectively

TABLE 28

ALTERNATIVES FOR COMPUTING POPULATION ESTIMATES
(PETERSEN METHOD) OF YUKON RIVER KING SALMON, 1966
FLAT ISLAND-MIDDLE MOUTH DATA COMBINED

Data Used	Tags	Recoveries	Catch[1/]	Pop. Estimate
I. All recoveries Total catch	573	172	111,000	369,784
II. All recoveries by 8½ inch gear, Commercial Catch [2/]	573	169	96,000	325,491
III. Y-1 recoveries Y-1 Total Catch	573	126	72,000	327,428
IV. Condition 1 tags only All recoveries minus Flat Is. and downstream recoveries. Total Catch minus Flat Is. and downstream catch.	384	106	107,000	387,622
V. Same as IV but recoveries by 8½ inch gear only [2/] Commercial Catch with 8½" gear.	384	103	92,000	342,990
VI. Same as IV but Y-1 recoveries and Y-1 Total Catch	384	89	72,000	310,651
VII. Same as IV but Y-2 recoveries and Y-2 Total Catch only	384	22	18,433	321,739
Flat Island Data Only				
VIII. Condition 1 tags, 334-12 Commercial Catch and recoveries, minus Flat Is. and downstream recoveries and catches.	279	29	16,000	153,931
Middle Mouth Data Only				
IX Condition 1 tags, 334-15 Commercial Catch and recoveries	105	9	11,000	128,333
Totals of VIII and IX (Estimate of South Mouth and Middle Mouth Runs)				282,264

1/ Commercial and subsistence catches including Yukon Territory catches.

2/ Does not include 3 fishwheel recoveries. Does not include 9 recoveries made by unknown gear (probably mostly 8½ inch nets)

TABLE 29

Numbers of Chum Salmon Tagged and Captured During 1965-1966,
Yukon River

Date	Flat Island, 1965[1/] Tagged	Unt.	Total	Flat Island, 1966 Tagged	Unt.	Total	Middle Mouth, 1966 Tagged	Unt.	Total	Combined Sites, 1966 Tagged	Unt.	Total
June												
6	0	0	0									
7	0	0	0									
8	0	0	0	0	0	0				0	0	0
9	1 (1)	0	1 (1)	0	0	0				0	0	0
10	0	0	0	0	0	0				0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	2 (1)	7	9 (1)	0	0	0	0	0	0	0	0	0
13	0	5	5	0	0	0	0	0	0	0	0	0
14	1	1	2	0	0	0	0	1	1	0	1	1
15	5	12	17	1	1	2	0	0	0	1	1	2
16	98 (44)	15	113 (44)	0	19	19	0	5	5	0	24	24
17	270 (192)	395 (26)	665 (218)	8	9	17	3	5	8	11	14	25
18	40 (26)	27 (4)	67 (30)	26	28	54	6	8	14	32	36	68
19	15 (13)	13	28 (13)	7	27	34	8	6	14	15	33	48
20	177 (157)	273 (132)	450 (289)	2	6	8	0	3	3	2	9	11
21	38 (38)	277 (108)	315 (146)	1	1	2	0	0	0	1	1	2
22	78 (68)	58 (2)	136 (70)	12	20	32	12	5	17	24	25	49
23	70 (64)	31	101 (64)	3	12	15	2	1	3	5	13	18
24	128 (115)	65 (21)	193 (136)	1	6	7	8	8	16	9	14	23
25	5 (3)	9 (6)	14 (9)	4	11	15	17	24	41	21	35	56
26	5	3	8	10	10	20	6	1	7	16	11	27
27	5	270	275	0	4	4	0	0	0	0	4	4
28	10 (6)	3 (1)	13 (7)	1	4	5	2	1	3	3	5	8
29	17 (16)	9 (1)	26 (17)	6	12	18	1	37	38	7	49	56
30	4 (3)	4 (2)	8 (5)	3	5	8	0	59	59	3	64	67

TABLE 29 (Continued)

Date	Flat Island, 1965[1/] Tagged	Unt.	Total	Flat Island, 1966 Tagged	Unt.	Total	Middle Mouth, 1966 Tagged	Unt.	Total	Combined Sites, 1966 Tagged	Unt.	Total
July												
1	5 (5)	0	5 (5)	4	2	6	0	0	0	4	2	6
2	11 (9)	20	31 (9)	19	13	32	3	3	6	22	16	38
3	78 (76)	33 (3)	111 (79)	9	7	16	2	0	2	11	7	18
4	2 (2)	0	2 (2)	7	11	18	21	25	46	28	36	64
5				4	33	37	3	15	18	7	48	55
6				10	20	30	22	44	66	32	64	96
7				3	5	8	4	9	13	7	14	21
8				16	25	41	0	7	7	16	32	48
9				11	14	25	5	11	16	16	25	41
10				6	8	14	0	0	0	6	8	14
Totals	1065 (939)	1130 (306)	2598 (1145)	174	339	737	125	278	403	299	591	890

1/ Numbers of chums captured by fishwheel are shown in parenthesis

Figure 4 depicts the timing of the 1965 and 1966 runs at the Flat Island site. The catch per hour data is from a single 25 fathom, 8½ inch mesh gill net fished in the same general area each season. Chum salmon were most abundant from June 17 to about June 26 during both seasons.

Gear Efficiency

Appendix Table A-6 shows numbers captured and tagged by each type of gear fished during the two seasons. Also the number of hours fished and the resultant catch per hour of each gear type is presented in this table. Much of this data is not comparable as the various gear types were often fished during different days and, therefore, during different stages of the run.

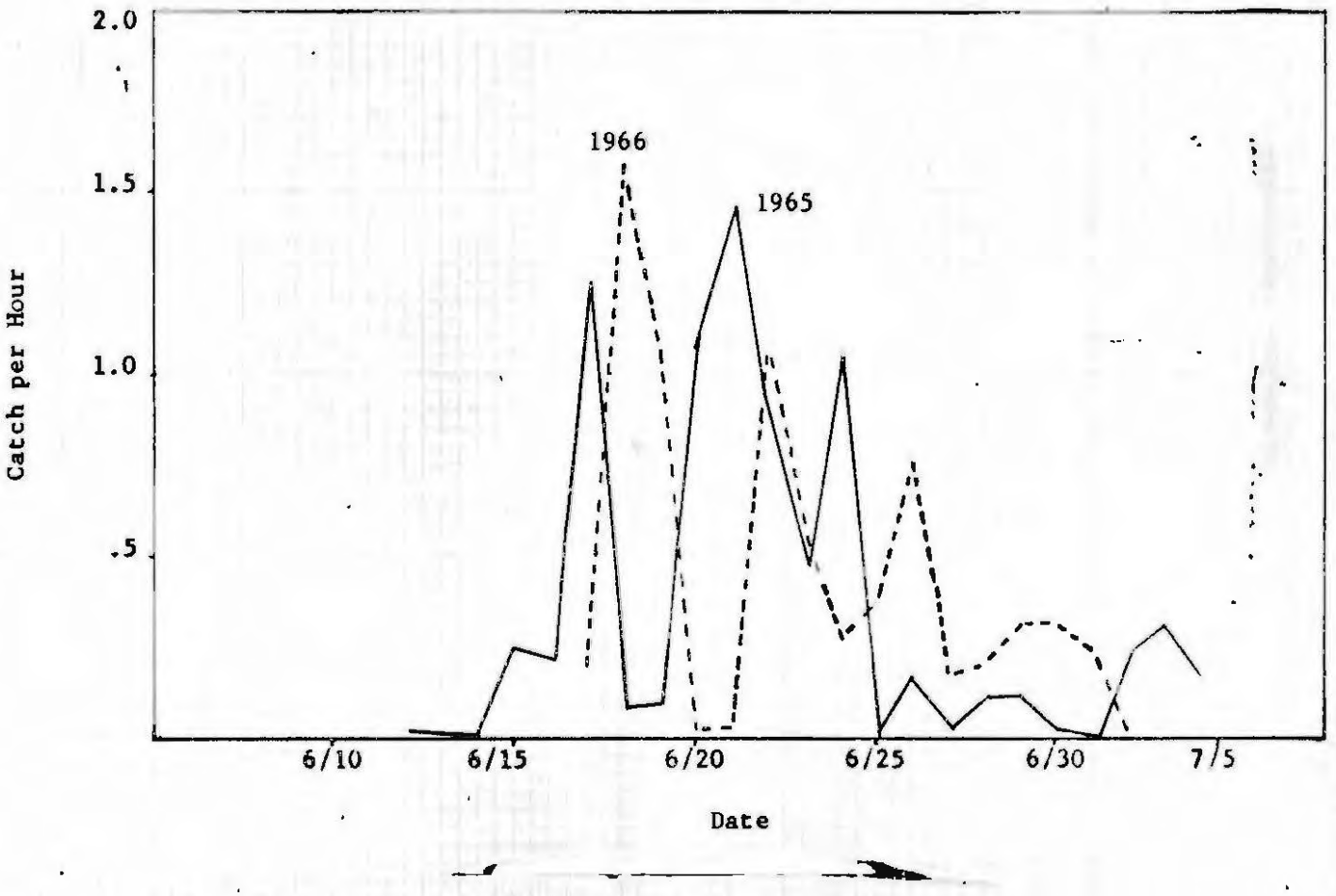
However, some comparisons can be made. During 1965 the fishwheel and 8½ inch mesh gill nets were fished throughout most of the June 6- July 4 period. The fishwheel catch per hour (2.28) during this time was much greater than that for 8½ inch mesh gill nets (.40). The catches per hour for all gear types fished during 1966 were less than in 1965 which indicates a smaller run.

Sex and Size Composition of Tagged Chum Salmon

Appendix Table A-7 shows the mean fork length and sex composition for each type of gear. The very limited data indicates that the 5½ inch mesh gill nets were selective to the smaller fish, most of which are females, and the 7 inch mesh gill nets were selective to the larger fish, most of which are males. The larger mesh gill nets (8½ and 10 inch) may not be very selective for size as most of the chum salmon captured in this gear were not gilled but became entangled by their mouths or snouts. The fishwheel sample was composed of a greater percentage of females (52%) compared to all gill nets operated during 1965 with the exception of the 5½ inch mesh gill net. Larger samples collected throughout the run are required before any definite statements regarding selectivity by gear can be made.

FIGURE 4

CHUM SALMON CATCH WITH A 25 FATHOM
GILL NET (8½" MESH) FISHED AT FLAT ISLAND
DURING 1965 AND 1966



Tag Recovery

Table 30 shows the numbers tagged and recovered during the study period. A total of 64 or 6.0% of the chum salmon tagged during 1965 were recovered. In 1966 a total of only 12 or 4.0% of the tags out were recovered. Table 31 shows the area of recovery for all 1965 and 1966 tag recoveries.

Recovery rates for chum salmon tagged at the river mouth during the 1963-1966 period has ranged from 4.0% in 1966 to 11.9% in 1963. Only 117 and 136 chum salmon were tagged at the Flat Island site during 1963 and 1964 respectively.

TABLE 30

Numbers of Chum Salmon Tagged by Gear and Recovered
During 1965-1966, Yukon River[1/]

Tagging Gear	Flat Island, 1965		Flat Island, 1966		Middle Mouth, 1966		Combined Sites, 1966	
	Tagged	Recovered	Tagged	Recovered	Tagged	Recovered	Tagged	Recovered
10 inch mesh	20	5(25.0%)	0	-	0	-	0	-
8½ inch mesh	108	10(9.3%)	89	7(7.9%)	65	3(4.6%)	154	10(6.5%)
7 inch mesh	16	3(18.8%)	23	0(0.0%)	0	-	23	0(0.0%)
5½ inch mesh	82	1(1.2%)	62	0(0.0%)	60	2(3.3%)	122	2(1.1%)
Totals Gill Net	226	19(8.4%)	174	7(4.0%)	125	5(4.0%)	299	12(4.0%)
Fishwheel	839	45(5.4%)	0	-	0	-	0	-
Totals - All Gear	1,065	64(6.0%)	174	7(4.0%)	125	5(4.0%)	299	12(4.0%)

1/ Percentage Recovery in parenthesis

TABLE 31

Recoveries of Tagged Chum Salmon By Area
1965-1966

Area of Recovery	Mileages fr. Tagging Site	1965 1/	1966 2/
South Mouth			
Below Flat Island		7	
Flat Island (tagging site)	0	6	2
Flat Is. - Alakanuk	1-11	12	2
Alakanuk	17	7	
Kwiguk - Emmonak	24	2	1
Aproka - Kwikpak Passes	30-43	1	
Middle Mouth			
Snotty Slough	20		2
Main River			
Fish Village - Anuk River	52-63	2	1
Patsy's Cabin - Mt. Village	71-87	5	
Old Andreafsky	97		1
Mouth, Andreafsky River	104	2	
Pilot Station	122	1	2
Ohagamut	185	1	
Russian Mission	213	2	
Holy Cross	279	2	
Mouth, Bonasila River	306	2	
Anvik & Vicinity	317- 366	3	
Nulato	484	2	
Galena	530	1	
Rampart	763	1	1
Koyukuk River			
Huslia	711	1	
Recovery Area Unknown	--	4	
TOTAL RECOVERIES		64	12

1/ Flat Island tagging site
2/ Flat Island and Middle Mouth tagging sites

TABLE A-1

KING SALMON FISHING EFFORT FOR A 25 F. GILL NET (8½ inch mesh), FLAT ISLAND
YUKON RIVER, 1963-1966

	1963			1964			1965			1966		
Date	Hours Fished	No.of Kings	Catch Per Hr.	Hours Fished	No.of Kings	Catch Per Hr.	Hours Fished	No.of Kings	Catch Per Hr.	Hours Fished	No.of Kings	Catch Per Hr.
June												
6							6.5	1	0.15			
7							18.4	0	0			
8	24	11	0.46				24	2	0.08			
9	24	41	1.71				24	5	0.21			
10	24	6	0.25				24	0	0			
11	24	64	2.67				24	5	0.21			
12	24	95	3.96				24	23	0.96			
13	24	10	0.42				24	11	0.46	7.5	0	0
14	24	2	0.08				24	10	0.42	24	0	0
15	24	44	1.83				24	5	0.21	17.5	0	0
16	24	61	2.54				24	17	0.71	16	4	.29
17	24	18	0.75				24	31	1.29	24	7	.29
18	24	7	0.29	4	2	0.50	24	1	0.13	24	54	2.25
19	24	68	2.83	8	11	1.38	24	91	3.79	24	22	.92
20	24	16	0.67	8	33	4.13	24	117	4.88	24	1	.04
21	24	2	0.08	8.5	48	5.65	24	66	2.75	24	1	.04
22	24	4	0.17	7.7	16	2.08	24	53	2.21	24	55	2.29
23	24	109	4.54	4	1	0.25	24	42	1.75	24	6	.25
24	24	25	1.04	0	-	-	24	36	1.50	24	4	.17
25	24	3	0.13	5.3	3	0.57	24	0	0	24	86	3.58
26	24	31	2.13	6	8	1.33	24	45	1.86	24	63	2.63

TABLE A-1 (CONT.)

Date	1963 Hours Fished	1963 No. of Kings	1963 Catch Per Hr.	1964 Hours Fished	1964 No. of Kings	1964 Catch Per Hr.	1965 Hours Fished	1965 No. of Kings	1965 Catch Per Hr.	1966 Hours Fished	1966 No. of Kings	1966 Catch Per Hr.
June												
27				6	15	2.50	24	7	0.29	24	9	.38
28				6	19	3.17	24	1	0.15	24	29	1.21
29				4	0	0	24	1	0.15	24	75	3.13
30				4.5	1	0.22	24	1	0.15	24	11	.46
July												
1				4	1	0.25	24	0	0	24	2	.08
2				3	18	6.00	24	5	0.21	24	9	.38
3				8	9	1.13	24	7	0.29	24	1	.04
4				9	9	1.00	6	1	0.15	24	2	.08
5				10.5	3	0.29				24	0	0
6				9.5	4	0.42				14	0	0
7				5	0	0				24	0	0
8				4.7	3	0.64				15	0	0
9				1.7	2	1.18						
10				2.7	1	0.37						
11				1.5	0	0						
12				1	3	3.00						
13				3.3	1	0.31						
TOTALS	455	637	1.40	135.9	211	1.55	654.9	586	0.89	572.0	441	0.77

APPENDIX TABLE A-2

Numbers of King Salmon Tagged and Captured with
Various Types of Gear at Yukon River Tagging Sites, 1965-1966

FLAT ISLAND, 1965

Tagging Gear	Tagged	Untagged	Total Catch	Total Hr. Fished	Catch Per. Hour
10 inch mesh (2 nets=50F.)	63	21	84	376.1	.22
8½ inch mesh (3 nets=60F.)	597	202	799	1,489.7	.54
7 inch mesh (1 net=25F.)	48	69	117	127.9	.91
5½ inch mesh (1 net=25F.)	0	2	2	43.1	.05
Total Gill Net (7nets=160F.)	708	294	1,002	2,036.8	.49
Fishwheel	111	3	114	502.5	.23
Combined gear	819	297	1,116	2,539.3	.44

FLAT ISLAND, 1966

8½ inch mesh (3 nets=60F)	377	251	628	1,124.0	.56
7 inch mesh (1 net=25F.)	10	25	35	192.0	.18
5½ inch mesh (1 net=25F.)	5	11	16	265.7	.02
Total Gill Net (5 nets=110F.)	392	287	679	1,581.7	.43

MIDDLE MOUTH, 1966

8½ inch mesh (3 nets=75F.)	172	109	281	1,030.4	.27
5½ inch mesh (1 net=25F.)	9	7	16	225.3	.07
Total Gill Net (4 net=100F.)	181	116	297	1,255.7	.24

APPENDIX TABLE A-3

Sex Composition and Mean Fork Lengths (in Centimeters) of Tagged King Salmon During 1965-1966, Yukon River[1/]

Flat Island, 1965

Gear	Males		Females		Combined Sexes		Percentage
	No.	Length	No.	Length	No.	Length	Females
10 inch mesh	41	93.5	22	87.9	63	91.6	35
8½ inch mesh	350	89.8	245	88.7	595	89.4	41
7 inch mesh	34	84.5	14	84.6	48	84.5	29
Totals-gill net	425	89.5	281	88.4	706	89.2	40
Fishwheel	65	77.9	44	82.4	109	79.7	40

Flat Island, 1966

8½ inch mesh	212	89.9	165	88.3	377	89.2	44
7 inch mesh	7	86.2	3	89.5	10	87.2	30
5½ inch mesh	3	83.7	2	83.0	5	83.2	40
Totals-gill net	222	89.7	170	88.4	392	89.1	43

Middle Mouth, 1966

8½ inch mesh	90	88.0	79	89.8	169	88.8	47
5½ inch mesh	5	90.4	4	92.0	9	91.1	44
Totals-gill net	95	88.1	83	90.0	178	89.0	47

1/ A few tagged king salmon were not measured or sexed. Therefore total numbers will be less than shown in other tables.

APPENDIX TABLE A-4

Numbers of Chum Salmon Tagged and Captured With
Various Types of Gear at Yukon River Tagging Sites, 1965-1966

FLAT ISLAND, 1965 (6/6-7/4)

Tagging Gear	Tagged	Untagged	Total Catch	Total Hrs Fished	Catch Per Hour
10 inch mesh (2 nets=50F.)	20	139	159	376.1	.42
8½ inch mesh (3 nets=60F.)	108	481	589	1,489.7	.40
7 inch mesh (1 net=25F.)	16	150	166	127.9	1.30
5½ inch mesh (1 net=25F.)	82	454	536	43.1	12.44
Total Gill Net (7 nets=160F.)	226	1,224	1,450	2,036.8	.71
Fishwheel	839	306	1,145	502.5	2.28
Combined Gear	1,065	1,530	2,595	2,539.3	1.02

FLAT ISLAND, 1966 (6/8-7/10)

8½ inch mesh (3 nets=60F.)	90	158	248	1,124.0	.22
7 inch mesh (1 net=25F.)	23	33	56	192.0	.29
5½ inch mesh (1 net=25.F)	61	122	183	265.7	.69
Total Gill Net (5 nets=110F.)	174	313	487	1,581.7	.31

MIDDLE MOUTH, 1966 (6/11-7/10)

8½ inch mesh (3 nets=75F.)	65	79	144	1,030.4	.14
5½ inch mesh (1 net=25F.)	60	199	259	225.3	1.15
Total Gill Net (4 nets=100F.)	125	278	403	1,255.7	.32

APPENDIX TABLE A-5

Sex Composition and Mean Fork Lengths (in Centimeters) of Tagged Chum Salmon During 1965-1966, Yukon River

/

FLAT ISLAND, 1965

Tagging Gear	Males No.	Males Length	Females No.	Females Length	Combined Sexes No.	Combined Sexes Length	Percentage Females
10 inch mesh	11	62.3	9	60.5	20	61.5	45
8½ inch mesh	56	62.8	45	60.0	101	61.5	44
7 inch mesh	9	67.1	7	62.8	16	65.2	44
5½ inch mesh	36	63.4	46	59.9	82	61.4	56
Total Gill Net	112	63.3	107	60.2	219	61.8	49
Fishwheel	401	62.8	436	59.0	837	60.8	52
Totals-All Gear	513	62.9	543	59.2	1,056	61.0	51
Flat Island, 1966							
8½ inch mesh	57	64.8	32	61.0	89	63.4	36
7 inch mesh	18	65.6	5	62.5	23	65.0	22
5½ inch mesh	20	61.6	42	57.8	62	59.0	68
Totals-Gill Net	95	64.3	79	59.4	174	62.1	45
Middle Mouth, 1966							
8½ inch mesh	36	63.9	29	62.2	65	63.1	45
5½ inch mesh	12	60.8	48	59.8	60	60.0	80
Totals-Gill Net	48	63.1	77	60.7	125	61.6	62